

Appl. No. 10/650,504
Amdt. Dated March 15, 2007
Reply to Office Action of December 15, 2006

Attorney Docket No. 81872.0052
Customer No. 26021

REMARKS/ARGUMENTS

Claims 13, 14, 20 and 21 are amended. New claims 24-26 have been added. Claims 13, 14, 20, 21 and 24-26 are pending in the application. Applicant believes that no new matter has been added. Reexamination and reconsideration of the application, as amended, are respectfully requested.

The present invention relates to a method suitable for use in texturing the surface of a silicon solar cell substrate or the like, and to a plate and a tray used therein. (*See, Specification, p. 1 lines 11-14*).

Applicant believes the foregoing amendments comply with requirements of form and thus may be admitted under 37 C.F.R. § 1.116(b). Alternatively, if these amendments are deemed to touch the merits, admission is requested under 37 C.F.R. § 1.116(c). In this connection, these amendments were not earlier presented because they are in response to the matters pointed out for the first time in the Final Office Action.

Lastly, admission is requested under 37 C.F.R. § 1.116(b) as presenting rejected claims in better form for consideration on appeal.

OBJECTIONS TO THE SPECIFICATION

The Specification stands objected to as failing to provide proper antecedent basins for the claimed subject matter. The Office states that explicit basis for the limitation "wherein a part of said chamber is connected to a ground," found in claims 13 and 20, appears to be missing from the Specification.

In response, Applicant has removed the limitation from claims 13 and 20. Withdrawal of this rejection is respectfully requested.

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CLAIM REJECTIONS UNDER 35 U.S.C. § 112

Claim 20-21 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. The Office states that in claim 20, line 7, the term "fine" is a relative term and that it has not been clearly defined in the specification or the prior art, and therefore the metes and bounds of the claim are unclear. The Office states that claim 21 fails to cure the indefiniteness of its base claim, and is therefore also rejected.

In response, Applicant has removed the term "fine" from claim 20. Reconsideration and withdrawal of the rejection are respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. § 102

Claims 20 and 21 stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent 5,417,798 (Nishibayashi).

Claims 20-21 also stand rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent 4,810,322 (Gut).

Applicant respectfully traverses these rejections. Claim 20, as amended, is as follows:

A method for producing a solar cell, comprising:
placing a substrate for a solar cell on an electrode
inside a chamber;
covering said substrate with a plate provided with
a number of opening portions;
forming textures on a surface of said substrate
using residues being chiefly composed of components of
the substrate as an etching mask,
wherein said plate is provided with a protruding
wall on a surface opposing said substrate and said
protruding wall is separated from a nearest surface of
said substrate by a space.

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Support for this amendment can be found at p. 8, lines 9-10; p. 12, line 12-p. 13, line 10 and p. 14, line 6 – p. 15, line 3 of the Specification.

Applicant respectfully submits that claim 20 cannot be anticipated or rendered obvious because Nishibayashi and Gut fail to teach or suggest "wherein said plate is provided with a protruding wall on a surface opposing said substrate and said protruding wall is separated from a nearest surface of said substrate by a space."

It is an aspect of the present invention that protruding walls 16, 20 can be provided to the plate 14 on the surface opposing the substrate 1. This arrangement secures a space above the substrate 1, surrounded by the plate 14, and the protruding walls 16, 20. The above-mentioned sidewall portion 16 formed around the edge of the plate 14 is denoted "protruding wall 16", since it functions as a protruding wall of the invention. The protruding wall can comprise only the protruding wall 16 formed in a peripheral portion of the plate 14. (See, *Specification*, p. 21, lines 14-22; Fig. 12).

By securing a space above the substrate 1 in this manner, a concentration of the silicon residues, remaining in the space above the substrate 1, surrounded by the plate 14 and the protruding walls 16, 20, can stay at a constant level even when the substrate area is increased, regardless of the positions and the shapes of the inlet port 18a, which introduces a gas inside the chamber 18, and the exhaust port 18b. Hence, the residues can adhere to the surface of the substrate 1 homogeneously, and the homogeneity in etching can be thus improved. (See, *Specification*, p. 21, line 23 – p. 22, line 6; Fig. 2, Fig. 12)

In contrast, Nishibayashi in Fig. 5 discloses a metal grid 9 that is supported on the insulator cylinder 30 and states that the metal grid 9 is not biased positively. The metal grid 9 is insulated via the cylinder 30. Consequently, the metal grid 9 and the insulator cylinder 30 must be different members from each other. Thus, the

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metal grid 9 cannot be said to have a "protrusion". (*See, Nishibayashi, col. 7, lines 9-11.*)

As such Nishibayashi cannot be said to teach or suggest "wherein said plate is provided with a protruding wall," as required by claim 20.

With regard to Gut, the Office states that Gut in col. 4, lines 46-47 discloses a protrusion from plate 30 toward the bottom plate. The Office goes on to state that this protrusion inherently discloses a protruding wall and that this is protrusion is suitable for producing a space between the plate and the substrate.

Applicant respectfully disagrees. Gut at col. 4, lines 42-55 discloses that this "protrusion" is a type of physical aberration, which may be holes or protrusions, for producing plasma glow disposed on the plate 30. Consequently, Gut's protrusion is provided to produce increased plasma glow. These highly active plasma regions indicated at 29 are generated about the aberrations 26 above the bottom plate 16 between the top plate 30 and the bottom plate 16, when the RIE system 10 is operating. (*See, Gut, Fig. 1; col. 3, line 50- col. 4, line 2*)

As discussed above, it is an aspect of the present invention that protruding walls 16 secure a space above the substrate 1. By securing a space above the substrate 1 in this manner, a concentration of the silicon residues, remaining in the space above the substrate 1, surrounded by the plate 14 and the protruding walls 16, 20, remain at a constant level even when the substrate area is increased, regardless of the positions and the shapes of the inlet port 18a, which introduces a gas inside the chamber 18, and the exhaust port 18b. Hence, the residues can adhere to the surface of the substrate 1 homogeneously, and the homogeneity in etching can be thus improved.

A protrusion that is an aberration, which is produced when the RIE system is operating, and which is provided to produce an area of increased plasma glow between the aberration and the bottom plate, does not teach or suggest that "said

plate is provided with a protruding wall on a surface opposing said substrate and said protruding wall is separated from a nearest surface of said substrate by a space," as required by claim 20. As such, Gut fails to cure the deficiencies of Nishibayashi.

In addition, Applicant respectfully submits that claim 20 cannot be anticipated or rendered obvious because Nishibayashi and Gut fail to teach or suggest "forming textures on a surface of said substrate using residues being chiefly composed of components of the substrate as an etching mask," as required by amended claim 20.

As discussed above, it is another aspect of the present invention that compounds are trapped between the silicon substrate 1 and the plate 14, and residues that are chiefly composed of silicon are formed on the substrate. The formation of the residues is promoted and thus texture 2 is easily formed on the substrate 1. During etching, silicon evaporates upon being etched, part of which, however, does not evaporate completely and molecules bond to one another, thereby being left as residues on the surface of the substrate 1. In other words, when the surface of the silicon substrate 1 is textured through the reactive ion etching method or a similar dry etching method, etching residues, chiefly composed of etched silicon, are allowed to re-attach to the surface of the silicon substrate 1. A re-attaching rate is accelerated, so that the textures 2 are formed on the surface of the silicon substrate 1 by using the residues as a micro-mask for etching. (*See, Specification, p. 12, lines 9-19; Figs. 1 and 2*)

In contrast, Nishibayashi discloses a diamond film grown on a synthesized diamond substrate, which is covered with a metal mask (*See, Nishibayashi, col. 4, line 49 - col. 5, line 2*). This diamond specimen 8 is placed in an RIE etching apparatus and is then etched to produce a smooth etched part with a surface

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roughness of less than 3 nm. (*See, Nishibayashi, Figs. 1 and 3; col. 4, line 49 – col. 5, line 46*)

A diamond specimen covered by a metal mask that is placed into an etching chamber and etched, so the etched surface is smooth does not teach or suggest a substrate on which textures are formed “on a surface of said substrate using residues being chiefly composed of components of the substrate as an etching mask,” as required by claim 20.

Gut discloses that a typical process uses a layer of masking material, photoresist, which is coated on the wafer on which the polysilicon layer of approximately 5000 angstrom has been deposited. Patterns are produced in the photoresist layer by a photographic process. The photoresist left behind protects certain regions of the thin film from etching in the RIE. (*See, Gut, col. 3, lines 19-25*)

However, Gut remains silent regarding a substrate on which textures are formed “on a surface of said substrate using residues being chiefly composed of components of the substrate as an etching mask,” as required by claim 20. As such, Gut fails to cure the deficiencies of Nishibayashi.

Moreover, in response to the Office’s statement in the “Response to Arguments” that “Growing films also forms textures on the surface of the substrate to be etched”, Applicant respectfully submits that there is no support in Nishibayashi for this statement. For example, Nishibayashi at col. 4, lines 23-25 specifically states, “However, this invention enables us to etch a surface of diamond smoothly” and discloses flat etching, as shown in Fig. 3. As such, if anything Nishibayashi teaches away from the present invention.

In light of the foregoing, Applicant respectfully submits that claim 20 cannot be anticipated or rendered obvious because Nishibayashi and Gut fail to teach or suggest each and every claim limitation. Claim 21 depends from claim 20 and

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cannot be anticipated or rendered obvious for at least the same reasons as claim 20. Reconsideration and withdrawal of the rejection are respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. § 103

Claims 13 and 14 stand rejected under 35 U.S.C. §103(a) as being unpatentable over the combination of U.S. Patent 5,503,881 (Cain) and Gut. Applicant respectfully traverses this rejection. Claim 13, as amended, is as follows:

A method for producing a solar cell, comprising:
placing a substrate for a solar cell on an electrode inside a chamber;
covering said substrate with a plate, wherein said plate is provided with a number of opening portions; and
forming textures on a surface of the substrate by using residues being chiefly composed of components of the substrate as an etching mask, wherein a distance between said substrate and a surface of said plate opposing said substrate in a peripheral portion of said plate is set shorter than a distance between said substrate and said surface opposing said substrate in a central portion of said plate.

Claim 13, as amended, includes the limitation "forming textures on a surface of said substrate using residues being chiefly composed of components of the substrate as an etching mask."

Applicant respectfully submits that claim 13 cannot be rendered obvious because Cain and Gut fail to teach or suggest "forming textures on a surface of said substrate using residues being chiefly composed of components of the substrate as an etching mask."

As discussed above, it is an aspect of the present invention compounds are trapped in between the silicon substrate 1 and the plate 14, and residues, with

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silicon as a main component, are formed on the silicon substrate 1. The textures 2 are formed on the surface of the silicon substrate 1 by using the residues as a micro-mask for etching.

In contrast, Cain discloses superior process uniformity in plasma processing systems can be achieved by providing a fluid distribution head having a non-planar dispersion plate (*See, Cain, col. 2, lines 5-7*). However, Cain fails to teach or suggest “forming textures on a surface of said substrate using residues being chiefly composed of components of the substrate as an etching mask,” as required by claim 13.

Furthermore, Cain also discloses that a process gas flows from a gas source 45 into a chamber 48 of the fluid distribution head 42 and then exits through a number of apertures 50 in a non-planar dispersion plate 52 of the fluid distribution head 42. The process gas flows toward a semiconductor wafer 54 as indicated by arrows 55. (*See, Cain, Fig. 2; col. 3, lines 1-10*)

Applicant respectfully submits that the dispersion plate 52 with a number of holes 50, as disclosed by Cain, is a gas flow inlet and cannot be said to teach or suggest a plate that covers a substrate as defined by the present invention. As such Cain fails to teach or suggest a “covering said substrate with a plate, wherein said plate is provided with a number of opening portions” as required by claim 13. Gut cannot be said to remedy the deficiencies of Cain for the reasons discussed above.

In light of the foregoing, Applicant respectfully submits that Cain and Gut cannot render claim 13 obvious, because the cited references fail to teach or suggest each and every claim limitation. Claim 14 depends from claim 13, and cannot be rendered obvious for at least the same reasons as claim 13. Reconsideration and withdrawal of this rejection is thus respectfully requested.

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NEW CLAIMS

Support for new claim 25 can found at p. 22, lines 19-32 of the Specification, which states:

As shown in Fig. 12, it is preferable that the lower end portion 21 of the protruding wall 20 abuts on the electrode 9 or the tray 13. This arrangement can prevent an abnormal discharge between the lower end portion 21 of the protruding wall 20 and the electrode 9.

Both Gut and Nishibayashi do not disclose a structure wherein the protrusion is in contact with the electrode.

Regarding new claim 26, Nishibayashi discloses a "diamond" as a substrate for etching and does not teach or suggest "wherein the substrate for a solar cell is a silicon substrate," as required by new claim 27.

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number (310) 785-4600 to discuss the steps necessary for placing the application in condition for allowance.

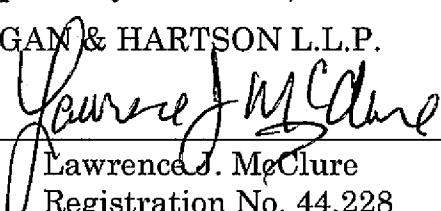
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Respectfully submitted,

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